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greater extent and more complicated. If, however, Keeler's band in α Orionis λ5669 to λ5682 is added, and the photograph of μ Geminorum (*Publication of the Yerkes Observatory*, vol. ii. No. 5, plate 10) is studied, it will be seen that the result is very similar in R Cygni, save that the commencement is slightly more refrangible. From this point to Hβ the spectrum becomes such a mixture of bright and dark bands that it is no longer possible to distinguish the Third Type spectrum with certainty.

(2) Of the bright lines other than hydrogen, the one at λ6289 is the most remarkable. The helium line λ5016 is apparently bright with a dark line on the more refrangible side. This is probably the case with λ4922.

(3) In the second enlargement, containing the region between Hβ and Hγ, next to the brilliancy of these lines the most remarkable object is the dark band whose centre is λ4644. This has a striking similarity to the one in γ Cassiopeiæ as given by Sidgreaves (*M.N.*, lix. No 8, plate 9). Indeed, the spectrum in this region appears to have a certain resemblance in other details to that of γ Cassiopeiæ.

(4) The variation in the more refrangible hydrogen lines, mentioned by Professor Wright, finds its counterpart in the behaviour of Hα. It seems probable that when the maximum approaches the lines slowly brighten up in order of refrangibility, till at length the climax is reached with the brightening of Hα. By this time the more refrangible lines have faded down; then with the fading of Hα the lines of greater refrangibility brighten up again in order.

The Spectrum of R Cygni. By W. H. Wright, Astronomer at the Lick Observatory. (Plate 8.)

(*Communicated by the Rev. T. E. Espin.*)

With the hope that they will not be too late to accompany your paper on the spectrum of R Cygni, I am enclosing my measurements of the three spectrograms it was found possible to secure. These plates were photographed with a single-prism spectrograph attached to the 36-inch refractor. I greatly regret the inability to get a more extensive series of photographs, but we have had bad luck with our weather this winter. There has been practically no observing.

You ask for my opinion of these plates: it is hard to form an opinion of a variable star that is worth much, on the basis of three observations; but, speaking generally, a very remarkable feature appears to be that the continuous spectrum fades out in the blue. With most stars the photographic maximum is in the neighbourhood of 4500 A, but that is the point where the continuous spectrum of R Cygni ended, at the time of these observations.

Connected with this is the comparative faintness or absence of

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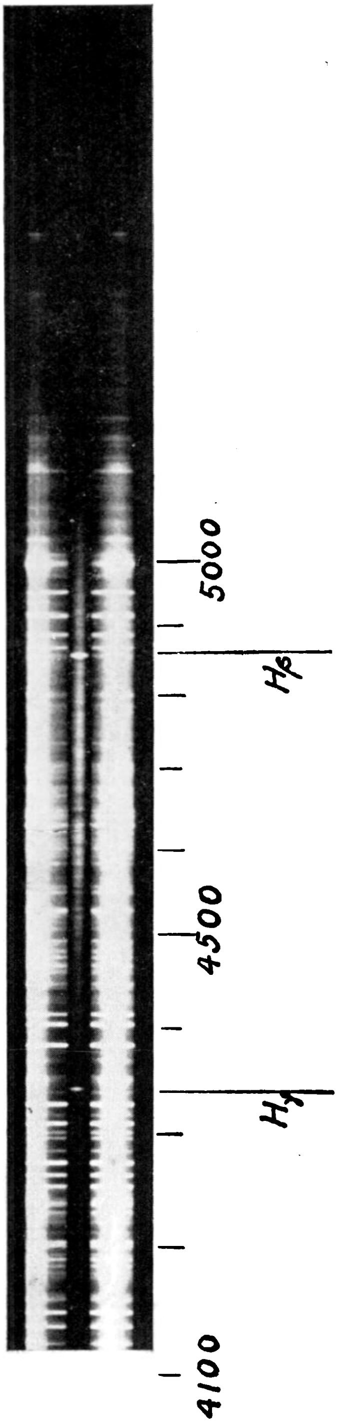
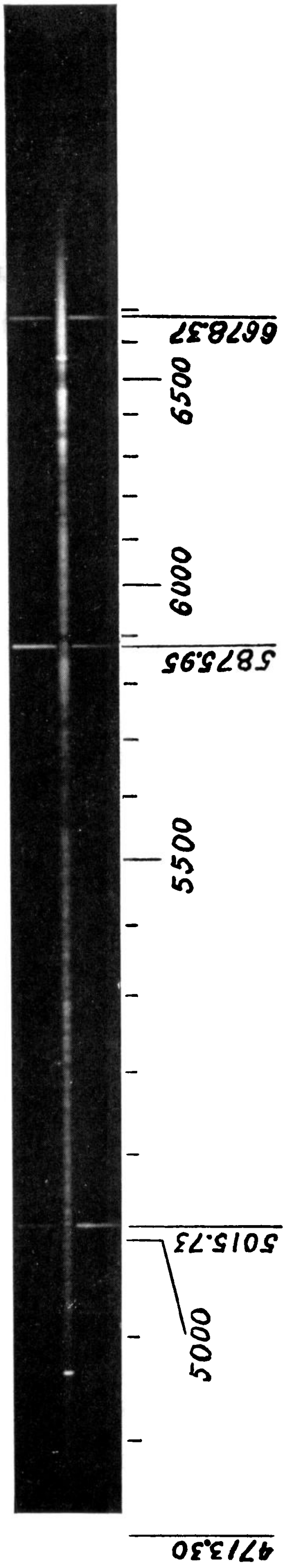


SPECTRUM OF R CYGNI. 1911 DEC. 5.



SPECTRUM OF R CYGNI. 1911 DEC. 11.—W. H. WRIGHT, LICK OBSERVATORY.

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the violet and ultra-violet members of the hydrogen series of bright lines. On the plate of December 5, H_γ is very bright, but there is only a trace of H_δ. On the plate taken 1912 January 13, H_γ is possibly a trifle fainter than on the former occasion, but H_δ is quite strong. No lines have been observed on the more refrangible side of H_δ.

These facts are strongly suggestive of absorption by an extensive atmosphere surrounding the star, and this absorption may well play an important part in causing the fluctuations of its light. It is easy to explain the absence of violet and ultra-violet light in the continuous spectrum by assuming a comparatively cold star, but here is an apparently perfectly good hydrogen series cut off in its prime above H_γ on December 5, and above H_δ on January 13. Under normal conditions the lines in such a series fade away gradually in intensity, and it therefore looks as though the seat of bright line radiation were surrounded by a medium exerting a powerful general absorption in the violet and ultra-violet. Furthermore, the increase in intensity of H_δ would seem to show that the amount of absorption is variable. Similar considerations may well apply to the continuous spectrum.

The notion that we are dealing with extensive *general* absorption in this star receives some support from the fact of the existence of great selective absorption as shown by the great breadth of most of the dark lines. For instance, the D lines form a blend extending from 5883 to 5902A, and others are perhaps equally broad.

One is tempted to speculate on the possible causes of such variations in absorption as are suspected, but three observations should not be made the basis of a variable star theory, and I shall have to rest content until it is possible to secure more. You have certainly interested me in this star, and I hope to observe it in the future.

The spectrum, as you see from the plates sent you, is considerably confused. It is impossible to measure everything in it, or to know in every case just what you are measuring. If you see anything that I have not measured you can get its approximate position, from your positives, with the aid of the paper scales which accompany this letter.

H_α and H_β (C and F) appear to be accompanied on their more refrangible sides by dark lines. Whether H_γ and H_δ are similarly provided with companions cannot be determined, as the continuous spectrum is too faint to photograph.

All of the hydrogen lines appear to be displaced negatively, as shown by the following comparison :—

Vacuum Tube.	R Cygni.	* – Tube.	Velocity.
4101·8	4101·4	– ·4A	– 30 km.
4340·6	4340·2	– ·4	– 28
4861·5	4860·7	– ·8	– 50
6563·0	6561·3	– 1·7 ±	(– 78 ± ±)

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The dispersion for the last line is so small that the residual is hardly significant. The others harmonise very well with the assumption of a velocity of approach of 30 or 40 km. per second.

It is to be regretted that it was impossible to photograph the H_β line under high dispersion. This would have been an easy matter, but the weather did not permit.

I have not had time to check my computations on which the wave-lengths given in the accompanying tables depend, but believe them to be free from serious errors. The small corrections to allow for the orbital motion of the Earth have been applied.

R Cygni.—Measurements of Spectrum.

1911 December 5. Plate No. 345.		1912 January 13. Plate No. 349.	
4101·7 ±	Suspect trace of bright line.	4101·4	Pretty strong bright line. H_δ 4101·85.
4340·2	Strong bright line.	4340·2	Strong bright line. H_γ 4340·66.
4447	Suspect very faint maximum.		
4497	Dark line in very faint continuous spectrum.		
4521·1	Narrow maximum.		
4530·1	Narrow maximum.		
4538·3	Faint narrow maximum.		
4549·9	Brightish maximum on border of dark line. Spectrum very faint above this point.		
4553·6	Dark line. Intensity = 3.		
4563·0	Hazy dark line. $i=2$.		
4571·7	Dark line. $i=1$.		
4579·7	Dark line. $i=2$.		
4583·3	Narrow maximum, possibly bright line.	4583·7	Narrow maximum, probably a bright line.
4592	Hazy dark line. $i=1$.		
4606·2	Dark line. $i=2$.		
4620·9	Dark line. $i=1$.		
4631·6	Narrow maximum (bright line ?)	4630·6	Narrow maximum, probably a bright line.
4633·7	Narrow dark line. $i=1$.		
		4638	Suspect maximum.
4640 }	Edge.		
4644·4 }	Broad dark line. $i=5$.		
4648 }	Edge.		
4651·2	Narrow maximum (bright line ?).	4651·1	Narrow maximum, probably bright line.
4655	Dark line. $i=1$.		

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R Cygni.—Measurements of Spectrum—continued.

1911 December 5. Plate No. 345.			1912 January 13. Plate No. 349.	
4668·3	Dark line.	$i=2$.		
4783·5 4790·7	Double dark line.			
			4795	Maximum of suspected hazy bright band.
4840·8	Dark line.	$i=1$.	4839·7	Dark line.
4853·2	Dark line.	$i=1$.	4853·9	Dark line.
4860·8	Very bright line.		4860·8	Very bright line. Hβ 4861·50.
4903	Dark line.	$i=1$.		
4920	Dark line.	$i=1$.		
			4928	Hazy maximum.
4956	Dark line.	$i=1$.	4958	Suspect dark line.
			5012	Dark line.
5039·8±	Dark line.	$i=3$.	5038·3±	Dark line.
5506	Suspect dark line.			

1911 December 11. Plate No. 346.	
4860·6	Strong bright line (Hβ)
4913	Dark line.
4921	Dark line.
4925	Dark line.
4932	Dark line.
4957	Dark line.
5014	Dark line.
5017	Slight maximum.
5022	Hazy dark line.
5039	Fairly sharp dark line.
5065	Suspect narrow dark line.
5149	Broad dark line.
5207	Dark line.
5224	Dark line.
5239	Dark line.
5249	Dark line.
5267	Dark line (looks double).
5283	Suspect dark line.
5297	Dark line.
5310	Dark line.
5356	Bright line or band ?

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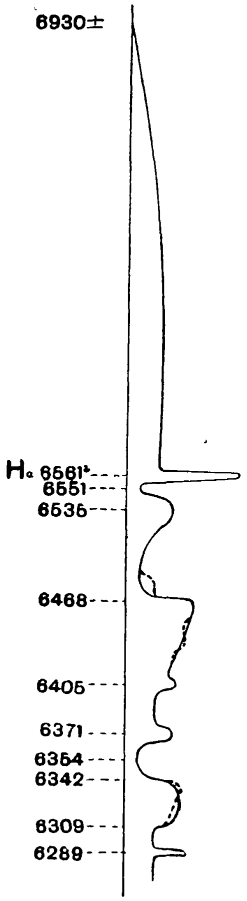
R Cygni.—Measurements of Spectrum—continued.

1911 December 11—*continued.*
Plate No. 346.

5360±	Between these limits there is considerable detail in the way of dark lines, which it is impossible to measure satisfactorily.
5500±	Between these limits spectrum is very faint.
5675±	
5713	Maximum, or bright band.
5767	Broad bright band. Maximum on less refrangible side of centre.
5851	
5883	Edge.
5893·0	*Very* strong, broad, dark line. $D_2 - D_1$ 5890·19–96·16.
5902	Edge.
5955	Suspect fairly narrow dark line.
6059	Hazy dark line.
6138	Broad dark line.
6160	Broad dark line.
6209	Hazy dark line.
6237	Hazy dark line (looks double).



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Below this point the spectrum is rather hard to describe in a table. The wave-lengths have therefore been attached to a sketch.

The indicated breadth of H_α does not mean that it is not monochromatic. The bright hydrogen lines, where not over-exposed, are about as broad as the comparison lines. 6289 looks like a monochromatic line.

The solid line sketch was made with the plate under the microscope. Subsequently, on examination of the negative with a lower power, details seem to be brought out which have been inserted in broken lines. The sketch is based on measurements of the negative, and the dispersion is therefore prismatic, so you can compare it directly with your positives—allowing, of course, for difference in scale.

Preliminary Observations of Spiral Nebulæ in Polarised Light.

By J. H. Reynolds.

A possible explanation of the stellar spectrum given by the great majority of spiral nebulæ is that some proportion of the light may be reflected from a central star or stars, involved in the nucleus. Long-exposure photographs tend to blot out the true character of the nucleus, which is usually globular in form with the maximum of light at the centre. The main reasons which favour the adoption of this as a provisional hypothesis may be enumerated as follows:—

1. The few cases in which spectrograms of spiral nebulæ have been secured include one at least where the continuous spectrum is crossed by bright lines of nebulium and hydrogen (N.G.C. 1068, 5-foot reflector, Mount Wilson). Sir William Huggins also recorded the existence of bright lines seen visually in the spectrum of the Andromeda Nebula (*Atlas of Representative Stellar Spectra*). The analogous character of cometary spectra is apparent.

2. In some authenticated instances of variable nebulæ, the nebulæ have been situated in close proximity to variable stars (T Tauri, R Coronæ Australis, Nova Persei).

3. Where spiral nebulæ are seen nearly edgewise, as is evidently the case with such examples as N.G.C. 3628, they are crossed by a dark band. It may be inferred that the matter forming the outer portions of the spiral is not sufficiently illuminated to affect the photographic plate, but is dense enough to absorb the light having its origin in the stellar nucleus.

It was suggested by Mr. F. J. M. Stratton that the hypothesis might be tested by means of polarised light, and Prof. Newall further proposed that a double-image prism should be used for photography. Both these valuable suggestions were adopted.

The first attempt to apply this test was made with a Nicol prism and positive eyepiece loaned by the Society, used in conjunction with the 28-inch reflector at Harborne. Some indications of